Glen H. Sturtevant, Kathleen T. Schneck, and Cathryn L. Leffler

Energy Technology Investments: Maximizing Efficiency through a Maritime Energy Portfolio Interface and Decision Aid

ABSTRACT

As the Navy continues to emphasize increasing Energy Security, many energy saving technologies and programs are in development and implementation to reduce the Navy's energy consumption and reliance on foreign energy sources. The Maritime Energy Portfolio Management Approach is a methodology to effectively identify, evaluate, prioritize, and manage energy saving technology and initiative installations on Ships through the Maritime Energy Portfolio Interface and Decision Aid. The Maritime Energy Portfolio Interface and Decision Aid is a dynamic graphic user interface backed by an intelligent database that allows for quick graphical data analysis, status tracking, and Scenario Analysis for progress toward established energy goals and recourse optimization. By increasing the effectiveness of managing the Maritime Energy Portfolio we enhance our responsiveness and reduce total ownership cost.

INTRODUCTION

Issues due to rising petroleum fuel costs have driven energy security to the front of strategic and operational threats for the US Navy. In response to this challenge, the Navy established Task Force Energy (TFE) to identify opportunities that would have the greatest impact on SECNAV energy goals established in Oct 2009[1]. Over half of the ships to be included in the Navy's 2020 Fleet are in-service today and as a result, it is necessary for the Navy to design, develop, and install Energy Conservation Measures (ECMs) into the Fleet as well as design and install ECMs in the ships of the future. ECMs are new and more energy efficient technologies and programs that aim to reduce energy consumption by making our fleet more energy conscious. Increasing energy efficiency and energy consumption awareness will increase time on station enhancing mission effectiveness and reduce fuel consumption, reducing total ownership cost. Technology investment today sets a priority on ship safety and capability, with a change to start including energy efficiency as a priority. Establishing Energy Security as a top priority will provide emphasis with the Navy to design, procure, produce, and install ECMs into the ships, driving the Navy toward Energy Security. In support of emphasizing Energy Security through the implementation of ECMs, the Maritime Energy Portfolio Management Approach was developed to increase effectiveness and ultimately lower total ownership cost.

THE MARITIME ENERGY PORTFOLIO MANAGEMENT APPROACH

The Maritime Energy Portfolio Management Approach provides a means for determining the best course of action where several initiatives compete for scarce funds or resources involving complex evaluation factors. An end-to-end, sustainable Maritime Energy Portfolio Management Approach will provide the infrastructure to identify, evaluate, prioritize, manage, and measure the installation of Energy Technologies for in-service ships by utilizing the Maritime Energy Portfolio Interface and Decision Aid.

The Maritime Energy Portfolio Interface and Decision Aid

The Maritime Energy Portfolio Interface and Decision Aid allows for efficient cross-Navy use

Report Documentation Page

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14. ABSTRACT
As the Navy continues to emphasize increasing Energy Security, many energy saving technologies and programs are in development and implementation to reduce the Navy?s energy consumption and reliance on foreign energy sources. The Maritime Energy Portfolio Management Approach is a methodology to effectively identify, evaluate, prioritize, and manage energy saving technology and initiative installations on Ships through the Maritime Energy Portfolio Interface and Decision Aid. The Maritime Energy Portfolio Interface and Decision Aid is a dynamic graphic user interface backed by an intelligent database that allows for quick graphical data analysis, status tracking, and Scenario Analysis for progress toward established energy goals and recourse optimization. By increasing the effectiveness of managing the Maritime Energy Portfolio we enhance our responsiveness and reduce total ownership cost.

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and application to quickly track, optimize, and analyze past, present, and projected fuel consumption and savings, and progress toward accomplishing established energy goals. The Maritime Energy Portfolio Interface and Decision Aid also provides a means for determining the best course of action where several ECMs compete for scarce funds. Efficient, user friendly use of the Maritime Energy Portfolio Interface and Decision Aid is possible through a fast, interactive, and dynamic Interface that serves to eliminate duplication of efforts in current management processes, increase efficiency, and optimize technology insertion into the fleet to reduce total ownership costs.

The Maritime Energy Portfolio Interface and Decision Aid will also serve as a repository of alternative technologies, attributes, and performance so that the in-service Fleet may monitor technologies in development as well as influence a fleet centric demand signal amongst the Navy's Energy Technology developers. This repository of information will be received and/or vetted through the Navy Program Managers and Subject Matter Experts for the various Energy Technologies. The Maritime Energy Portfolio Interface and Decision Aid has a modular, open architecture design in order to allow for dynamic technical and programmatic review processes and the insertion of new tools as ideas are modified and enhanced.

The Maritime Energy Interface and Decision Aid is successful due to two key components: an appropriate database infrastructure and a dynamic user interface. By building intelligence into the database, and database infrastructure, the process of rapidly inserting new data and data analysis is optimized to reduce human error and inefficiencies. Just as important as building an intelligent database is giving the database an effective user friendly interface for quick interpretation of analyses and dynamic data filtering. Although the Maritime Energy Interface and Decision Aid refers to the user interface that tracks progress and helps aid decision making, the interface cannot succeed without the right database intelligence and infrastructure behind it.

PORTFOLIO DATABASE INFRASTRUCTURE

The Intelligent Portfolio Database design enables the capabilities to ingest and analyze data from multiple data sources and export in order to populate the Commercial off the Shelf (COTS) Interface and Decision Aid. Figure 1 depicts the flow of data through the portfolio.

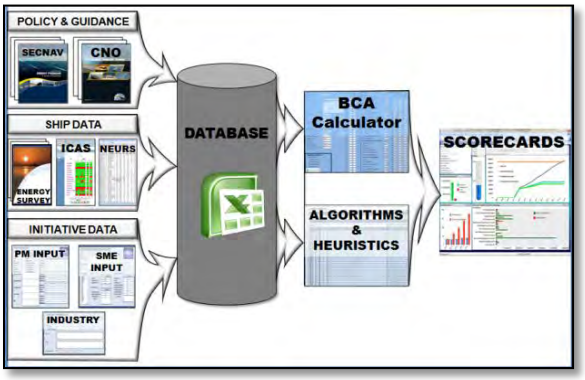
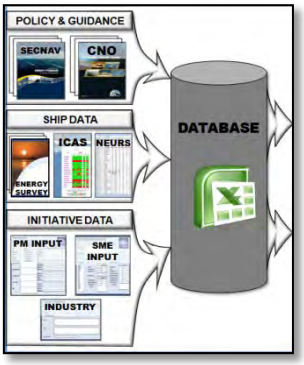


FIGURE 1. Intelligent Portfolio Database Design

Data Environment



The data environment for the Portfolio was structured using a relational database design. There are base tables that house raw data and relational tables that link the unique identifying attributes of both the ships and the initiatives in order to associate the different data and reduce repetition.

The required data for this portfolio comes from a variety of sources:

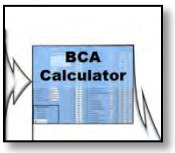
- U.S. Navy Policy and Guidance:
  - Chief of Naval Operations' *The Navy Energy Vision*[2]

    - Secretary of the Navy's *The Department of the Navy's Energy Goals*
- Ship Data:
    - Ship Class Baseline Survey Reports
    - Shipboard Data Collection and Display Systems
    - Navy Quarterly Fuel Consumption Database
- Initiative Data:
    - Program Managers
    - Subject Matter Experts
    - Industry and Academia

Upon input into the database, the above data is formatted and consolidated to ensure there is no unnecessary repetition.

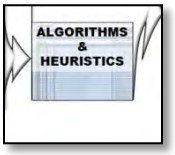
The data is stored on a per ship basis. In other words, for each ship data is collected for each potential initiative in order to accurately account for the ship's total fuel avoidance.

Data Analysis



Whenever it is necessary to make investment decisions, an intitiative's business case must be considered. In this section of the portfolio, the Business Case for the various initiatives is performed. Using the collected data described above, an initiative's business case is performed for each ship application. Outputs from the Business Case Analysis (BCA) include: Return on Investment (ROI) and Break Even Point (BEP). These metrics are essential for determining whether an initiative would be worth pursuing.

Balanced Portfolio



Once all the data is collected and the analysis is performed, it is now possible to start processing that information in order to develop a balanced, intelligent portfolio.

Algorithms developed for this portfolio will allow the user to perform the following analyses:

- Prioritizing the largest and least efficient consumers with the earliest initiative implementation opportunity.
- Balancing investments across initiatives of various technical maturities to ensure continuous energy improvements across the Navy Fleets of Today, Tomorrow, and Future.
- Performing Scenario Analysis (i.e. determine how investment decisions vary with different funding amounts; determine funding and initiative requirements to meet new performance objectives, etc.).

Optimization will be performed using heuristic modeling in order to accomplish the below:

- Maximizing ROI while Minimizing Total Cost.
- Performing Scenario Analysis (i.e. determine what the total cost would be for maximizing possible fuel avoided, etc.).

These techniques will allow the user to consolidate the various initiatives and ships to see an overall impact, or allow the user to drill down to the unit level for per ship or per initiative analysis.

PORTFOLIO INTERFACE AND DECISION AID

The Portfolio Interface and Decision Aid was developed to be a dynamic, graphic user interface to the Intelligent Portfolio Database that serves three main functions. The first of these is to track both the progress toward achieving the goals and individual ECM fuel savings. The second is to aid decision makers with live Scenario Analysis so limited resources can be used effectively. The last of these is to increase management efficiency by reducing duplication of efforts by standardizing interface format and report generation.

Tracking Fuel Savings and Progress Towards Energy Goals

In response to the SECNAV and CNO energy goals announced regarding increasing energy efficiency and reducing energy consumption by certain dates, the Navy has accelerated the development of ECMs. Although a number of these new ECMs have begun to be implemented on ships, many ECMs are installed as Proof of Concept (POC) demonstrations or are in the early stages of transitioning from either R&D to POC, or from POC to full scale implantation. This makes the tracking of the ECMs statuses in phases of R&D, POC, and Implementation essential to accurately represent actual progress toward energy targets and the projected path to achieving energy goals.

The Portfolio Interface and Decision Aid provides an ECM Scorecard where the characteristics of all the ECMs are tracked and an Executive Summary of fuel savings against the goals. ECM Scorecards were created to track characteristics like fuel savings, Business Case, and milestones that are kept up to date to give a quick snapshot of an ECM's profile. All ECM profiles are automatically generated in a standardized scorecard to allow for quick analysis of all ECMs. This is made possible through filtering; when an ECM is selected from a list the scorecard automatically updates with the ECM's information. This can be seen in Figures 2 and 3 where the profiles of two ECMs are populated into the developed scorecard structure. This has proven to be an effective method of keeping ECM characteristics up to date as Navy Program Managers and/or Subject Matter Experts can quickly identify inaccuracies and areas that require updating for their respective ECMs.

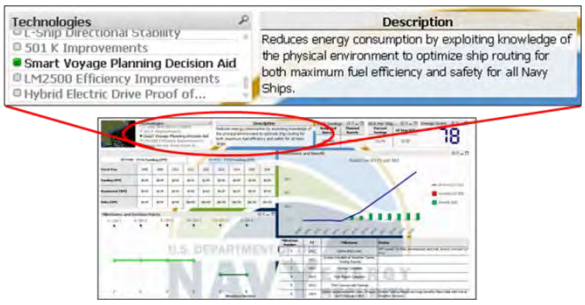


FIGURE 2. Profile of ECM Smart Voyage Planning and Decision Aid loaded into ECM Scorecard

FIGURE 3. Profile of ECM Stern Flaps loaded into ECM Scorecard

ECM characteristics feed into the Executive Summary Scorecard that provides an over arching view to all energy saving efforts. Figure 4 shows a notional Executive Summary Scorecard that can be used to give a clear and quick update on how the Navy's ECMs are progressing to meet the energy goals. Besides tracking savings toward energy goals, other important summary characteristics include total ECM installations by FY and total Benefit vs. Investment.

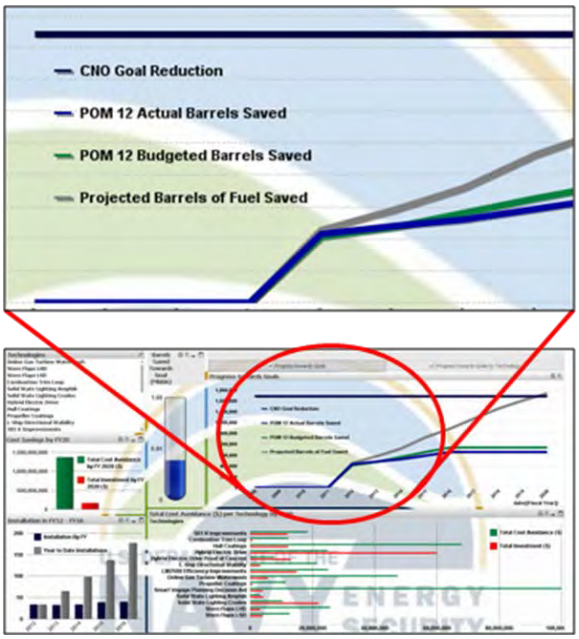


FIGURE 4. Executive Summary with chart showing progress towards energy goals

Investments Decision Aid through Scenario Analysis

Today's Navy is confronted with the challenge of reducing energy consumption, while working in an environment of constrained budgets and resource competition. Scenario Analysis allows for the user to determine the priority of ECM characteristics including: total savings, payback period, breadth of influence, and mission capability influence, against user selected funding scenarios to find a user optimized solution. Scenario Analysis is made possible by the optimization algorithms and heuristic modeling in the database with some user control of range and percentage in the interface. This allows for the most effective use of resources in meeting energy goals and increasing Energy Security.

Portfolio Interface and Reporting

A COTS Interface was selected for application in the Portfolio Interface and Decision Aid that met the following criteria:

- Ability to import multiple file types
- Automatic establishment of data relationships
- Dynamic data filtering ability
- Ability to export tables and figures
- Automatic report generation

By minimizing the amount of file manipulation needed to allow the file to be correctly imported by the Interface, the Interface was able to become usable faster and would allow for future files to be incorporated with minimal manipulation and time. Automatic establishment of data relationships also allowed for the Interface to become operational quicker and reduced potential user error from manually establishing data relationships. In order for the Interface to enable quick visual analysis of data, dynamic data filtering was required to allow the user to populate predetermined charts and tables based on a data selection or a range of selections. This greatly reduced duplication of efforts and allowed for a standardized format. A reporting element was also required for the user to select a range or one ECM, Date, Ship class, etc. and select print reports to have all the information populated and printed in a predetermined format for all values selected. This also reduced duplication of efforts or generating and gathering updates, often in different formats. The resulting Interface and Decision Aid increases our effectiveness towards reducing total ownership cost.

CONCLUSION

The Maritime Energy Portfolio Interface and Decision Aid is a combination of intelligent database and graphic user interface that manages current ECMs and progress toward goals in a standardized format, aids in balancing investments and resource Scenario Analysis. The Maritime Energy Portfolio Interface and Decision Aid is key in the Maritime Energy Portfolio Management Approach which aims to prioritize, analyze, and manage identified energy savings concepts for in service ships in the most effective manner. The Maritime Energy Portfolio Management Approach increases the focus on ensuring future Energy Security for the Navy.

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[1]Mabus, R. (October 2009). The Department of the Navy's Energy Goals. Retrieved from http:// www.navy.mil/features/Navy_EnergySecurity.pdf

[2]Cullum, P. Presentation of The Navy Energy Vision (October 2010). Navy Energy Forum. A Navy Energy Vision for the 21st Century. Regan Building and International Trade Center Washington, DC. Retrieved from: http://greenfleet.dodlive.mil/files/ 2010/10/Navy-Energy-Vision-Oct-2010.pdf

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Kathleen T. Schneck *is a Senior Engineering Consultant at Herren Associates and supports the Navy's efforts to reduce energy costs by assisting the development and management of NAVSEA's Maritime Energy Portfolio of Technologies. Ms. Schneck is a certified Lean Six Sigma Black Belt and a graduate of the Georgia Institute of Technology with Highest Honors and a degree in Industrial Engineering.*

Cathryn L. Leffler *is an Engineering Consultant at Herren Associates and works in a team of engineers in the evaluation of Naval and Marine Energy Technologies and their impact on the Navy's Energy Posture as well as supporting technology development, integration, and insertion. A graduate of Virginia Polytechnic Institute and State University, Ms. Leffler carries a degree in Mechanical Engineering.*

ENERGY TECHNOLOGY INVESTMENTS:
Maximizing Efficiency through a Maritime Energy Portfolio Interface and Decision Aid

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Lean Six Sigma Black Belt

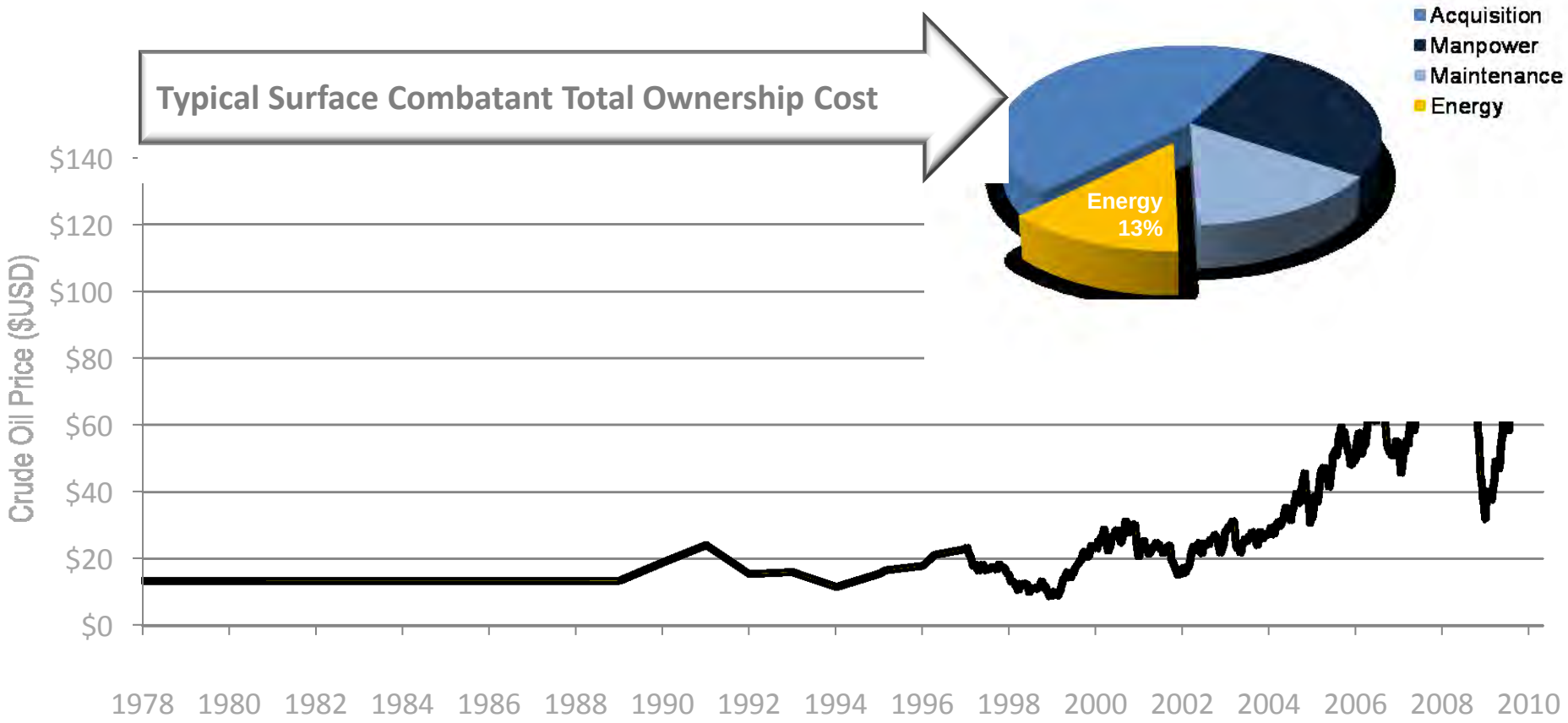
Glen Sturtevant
Program Executive Office, Ships
Science & Technology Director
Program Manager

9 Feb 2012

Outline

- ENERGY AS A NAVY IMPERATIVE
- MARITIME ENERGY PORTFOLIO PROCESS
- MARITIME ENERGY PORTFOLIO INTERFACE
- IMPACT TO NAVSEA ENERGY PROGRAM

Navy Energy Profile



Energy Demands and Costs Continue to Rise

Manpower and Maintenance Budgets are Challenged

We Have the Ability to Control Acquisition Costs

US Navy Tactical Energy Goals

INCREASE ALTERNATIVE ENERGY USE DON-WIDE

- By 2020, 50% of total DON energy consumption will come from alternative sources.

SAIL THE "GREAT GREEN FLEET"

- DON will demonstrate a Green Strike Group in local operations by 2012 and sail it by 2016.

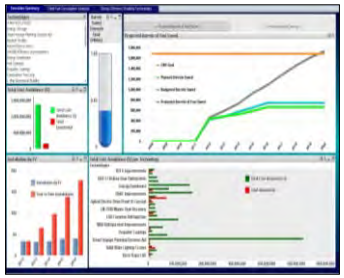
ENERGY EFFICIENT ACQUISITION

- Evaluation of energy factors will be mandatory when awarding contracts for systems and buildings.

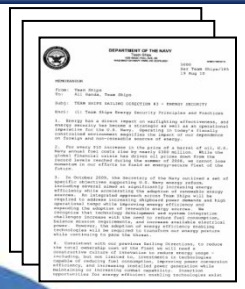
EFFICIENCY AND CONSERVATION AFLOAT

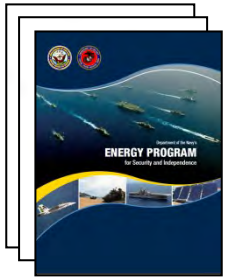
- By 2020, the Navy will increase efficiency and reduce overall fuel consumption afloat by 15%.

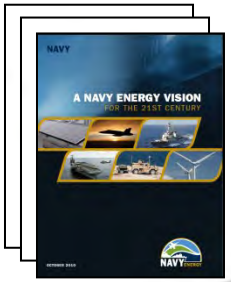
Energy Decision Framework



Evaluate Energy Scorecards



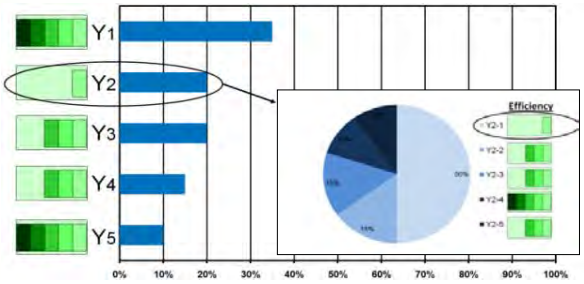




Policy & Guidance

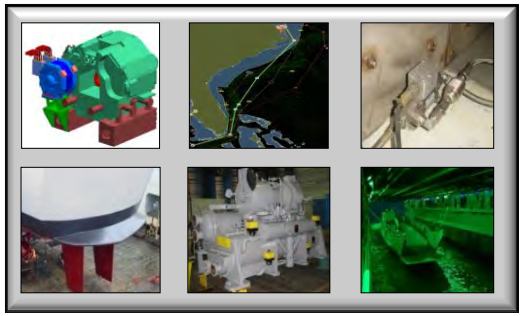
Technology Candidates

Analyze Fuel Consumption

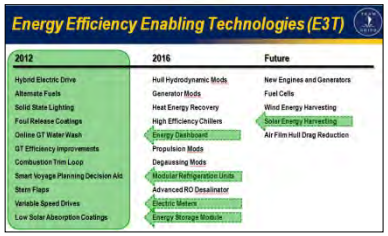


Identify Inefficiencies

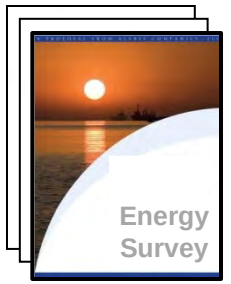
INITIATIVE	2012	2013	2014	2015	2016	FYDP	RS	
FFR&DP	1.8	1.4	1.5	3.5	4.0	12.6		Programs
Energy Storage RDTE	5.0	3.0	3.0	3.0	6.0	20.0	N86	
Nuclear Studies	2.0	2.1	2.1	2.2	2.3	10.7	N88	
Propeller Coatings	0.5	0.5	0.6	0.5	0.3	2.4		O&M
L-Ship Directional Stability	0.9	1.8	1.8	1.8	1.8	8.1	N85	
Marine Gas Turbine Initiatives	2.4	2.4	2.4	2.4	2.4	12.0		
Solid State Lighting (Crudes)	3.5	3.5	3.5	3.5	3.5	17.5	N86	
Stern Flaps (LSD)	1.6	1.6	1.6	1.6	0.8	7.2		
LM2500 Efficiency RDTE	3.0	11.0	2.0	0.0	0.0	16.0	N86	RDTE
Energy Dashboard / Hydrodynamics	5.1	1.0	0.8	0.2	1.9	9.0	N43	RDTE
TOTAL	38.4	44.3	65.5	92.1	93.5	333.8		



Develop Implementation Plan



Determine Possible Solutions



Energy Decision Framework

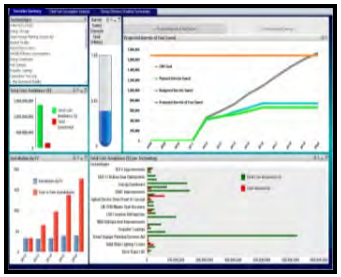
ENABLED BY

MARITIME

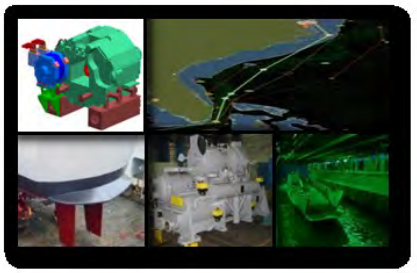
ENERGY

PORTFOLIO

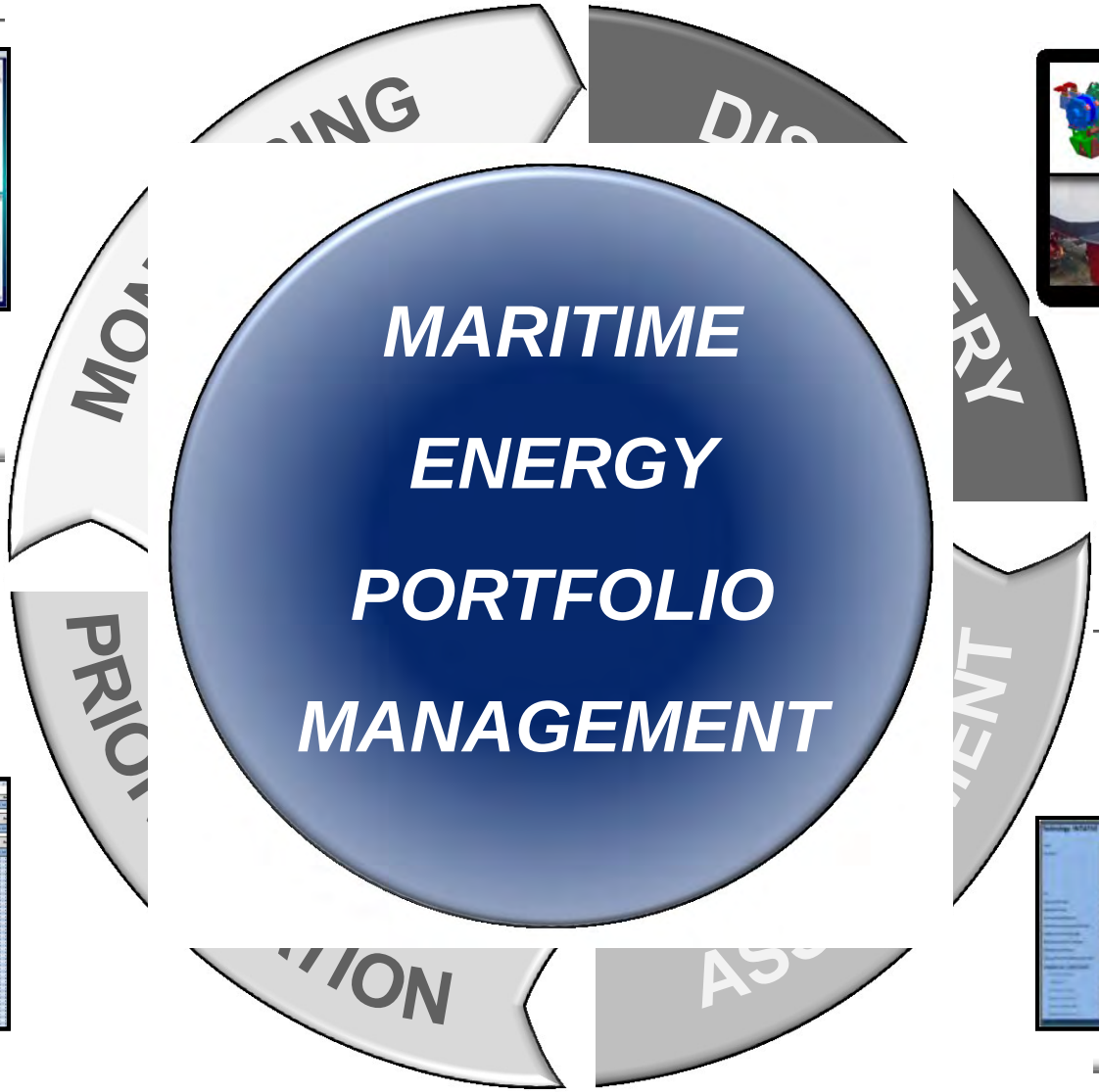
Maritime Energy Portfolio Process



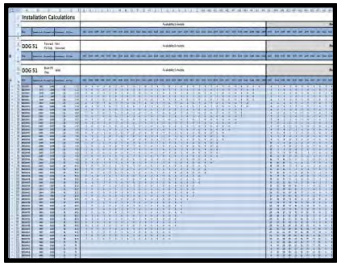
Impact
Performance



Outreach
Collaboration



Optimization
Metrics



Technical
Financial

Data Flow

PRIORITIZATION

Algorithms

Optimization

DISCOVERY

Ship Schedules

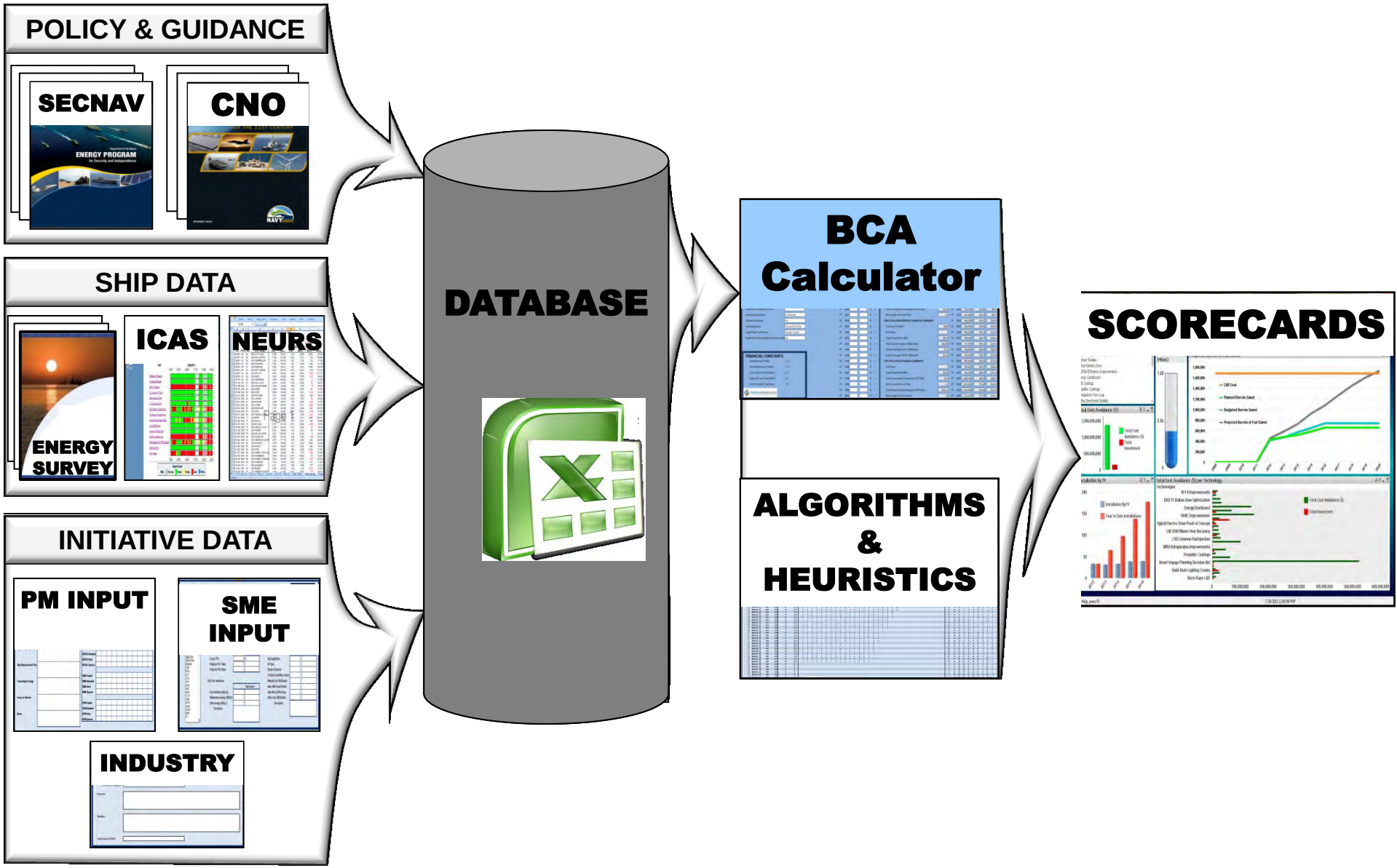
Fuel Burn

Scorecards

MONITORING

ASSESSMENT

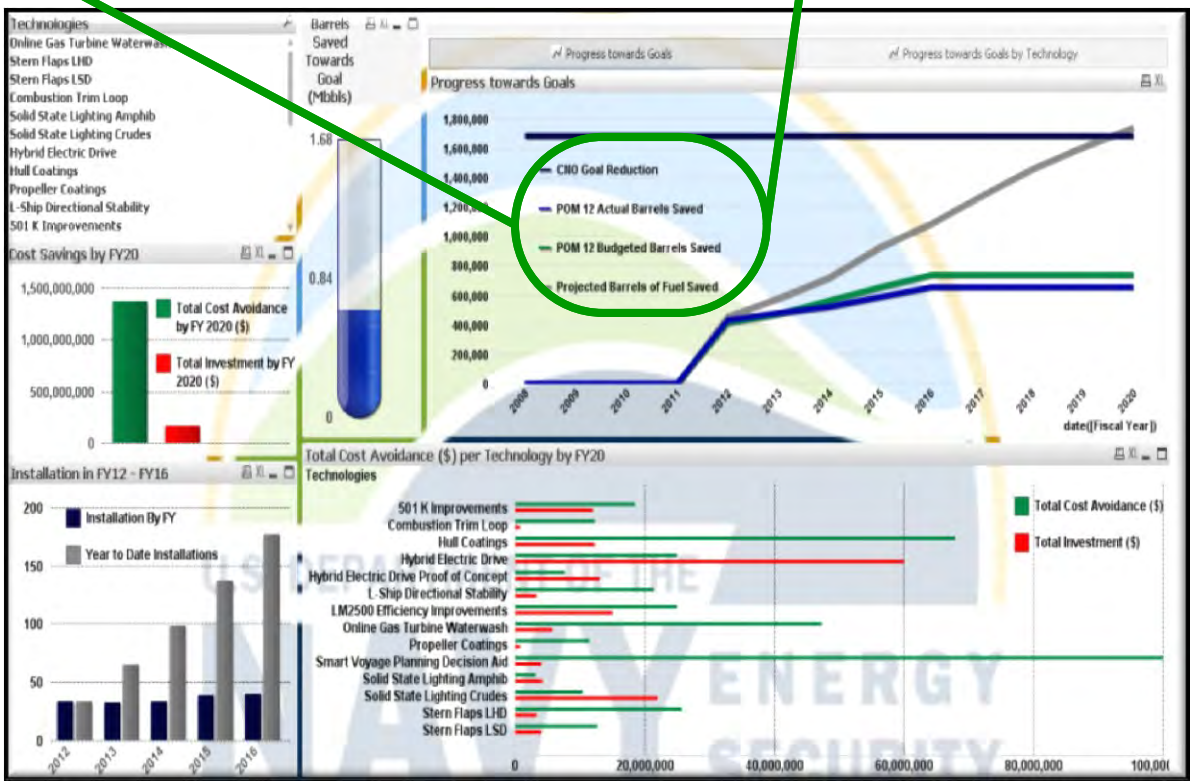
Data Sources & Tools



Executive Summary Scorecard

SCENARIO ANALYSIS

Allows for the user to determine the prioritization of the Energy Conservation Measures for various what-if scenarios.

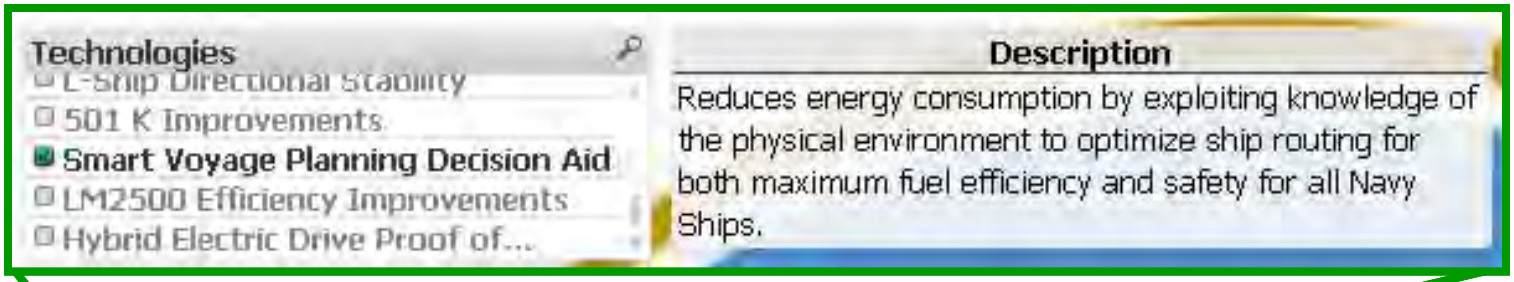


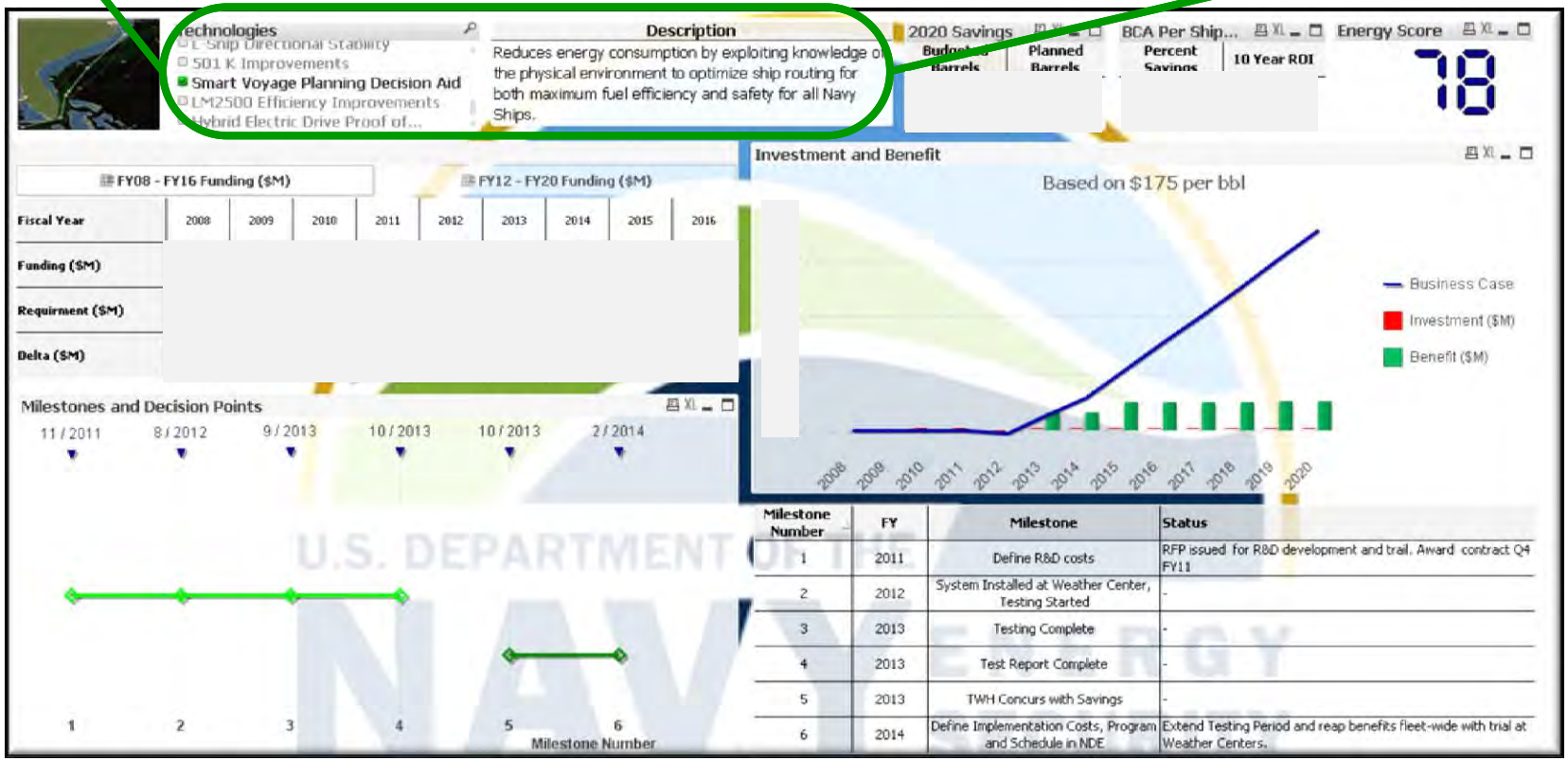
INFORMATIVE

Allows leadership to see essential data regarding the Maritime Energy Portfolio

- Progress towards Energy Goals
- High Level Business Cases
- Installation Plan

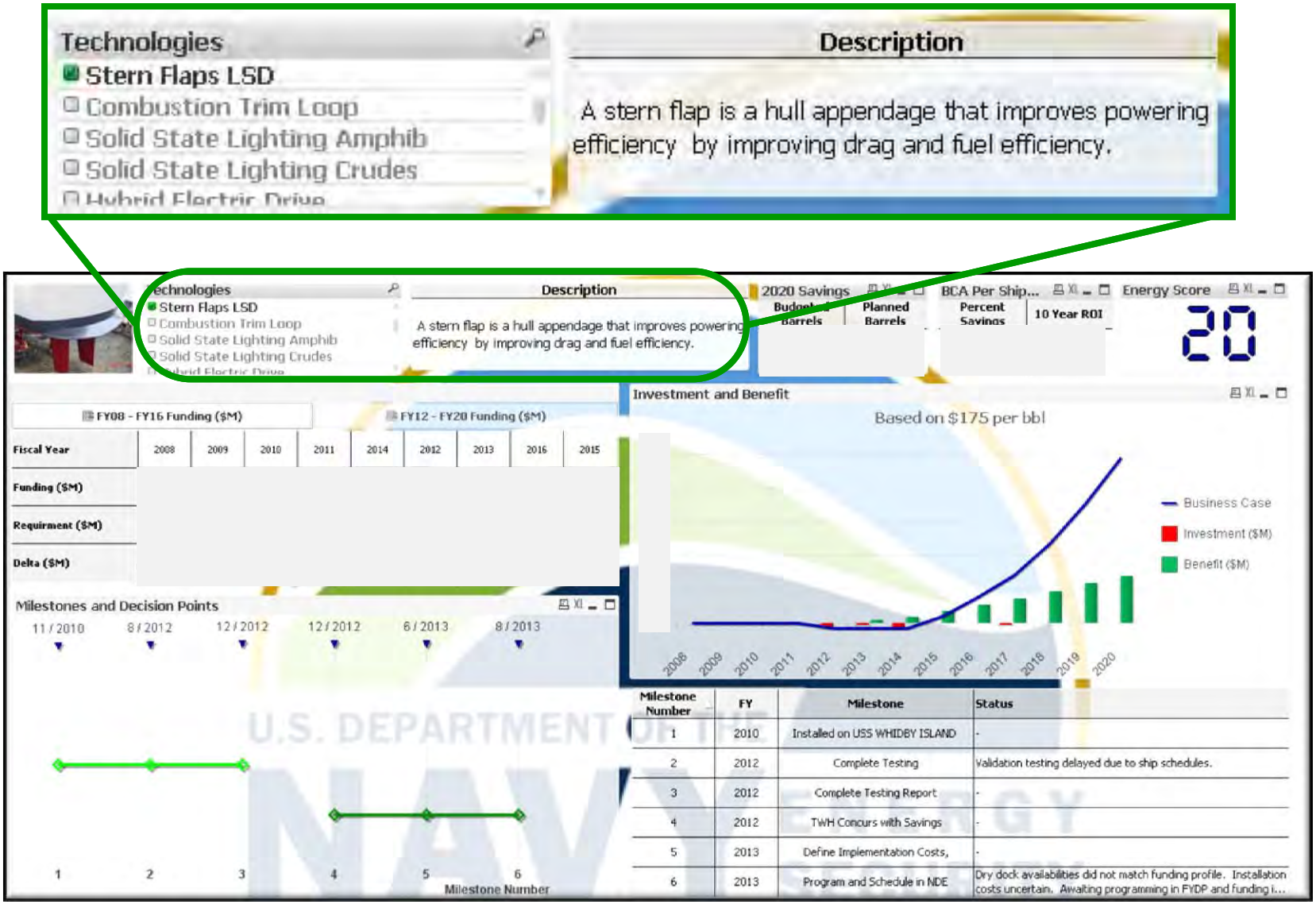
Initiative Status Scorecard (1)





Milestone Number	FY	Milestone	Status
1	2011	Define R&D costs	RFP issued for R&D development and trail. Award contract Q4 FY11
2	2012	System Installed at Weather Center, Testing Started	-
3	2013	Testing Complete	-
4	2013	Test Report Complete	-
5	2013	TWH Concurs with Savings	-
6	2014	Define Implementation Costs, Program and Schedule in NDE	Extend Testing Period and reap benefits fleet-wide with trial at Weather Centers.

Initiative Status Scorecard (2)



Conclusions

- Dynamic Interface with a Disciplined Cost Analysis Facilitates Investment Decision Aid Capability
- Portfolio Infrastructure Allows for Quicker, Repeatable Responses for Various What-If Scenarios
- Portfolio Structure Enables Standardized Reporting

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